Sound32

Traffic Noise Prediction Model

California Department of Transportation
Environmental Program
Environmental Engineering
Hazardous Waste and Noise/Vibration Office

Introduction

- Course in the mechanics of using Sound32

Purpose

The purpose of this course is to:

- Teach students the mechanics of using Sound32
- Provide students hands on experience using Sound32
- Introduce students to LeqV2 and Sound2000

The overall goal is for students to become fully conversant in the use of Sound32 by the end of the course.

Assumptions Regarding Students Experience

- This course assumes that students have completed the following training modules:
  - Module 1 - Fundamentals of Highway Traffic Noise
  - Module 7- Caltrans Traffic Noise Analysis Protocol
  - Module 8 - Noise Study Documentation and Reports
  - Module 5 - Traffic Noise Impact Analysis Procedure
  - Module 2 - Highway Noise Measurements and Instrumentation
- Basic functional capability in DOS, Windows, spreadsheet programs (i.e. Lotus, Excel, Quattro) is highly recommended.

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On Line Resources

- Sound32 users manual and reference sheets available on line at:

http://www.dot.ca.gov/hq/env/noise/software.htm

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Summary of Course Topics

- Background
- Factors that effect traffic noise
- Input parameters used in Sound32 analysis
- Sound32 modeling methodology
- Sound32 data entry
- Sound32 post-calculation menu
- Sound32 results menu
- Impact and abatement criteria
- Line of sight (LOS) analysis and Sound32 LOS module
- Modeling techniques
- Sound32 exercises
- Introduction to LeqV2 and Sound2000
- LeqV2
- Introduction to Sound2000

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Background

- Federal Highway Administration Traffic Noise Prediction Model (FHWA -RD-77-108) published in late 1970's
- Charts and nomographs were used to evaluate traffic noise
- LEQV2: Mainframe implementation of the FHWA -RD-77-108 model developed by Caltrans in the early 1980's
- STAMINA/OPTIMA: More sophisticated mainframe implementation of the model developed by FHWA.

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Background

- SOUND32: Mainframe implementation of STAMINA/OPTIMA developed by Caltrans in the early 1980's.
- In 1985 Sound32 was modified to include Calveno.
- Late 1980's DOS versions of LeqV2 and Sound32 were developed.
- Traffic Noise Model (TNM): New Windows model released by FHWA in 1998.
- Sound2000: Windows data-entry interface for Sound32 was introduced by Caltrans in 2000.

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Factors That Effect Traffic Noise

- Source/path/receiver concept
- Volume of traffic
- Vehicle type (trucks versus automobiles)
- Speed of traffic
- Geometric relationship between traffic and the receiver
- Grade of the roadway
- Barriers between traffic and the receiver
- Acoustical characteristics of the ground between traffic and the receiver
- Meteorology (temperature, humidity, wind)

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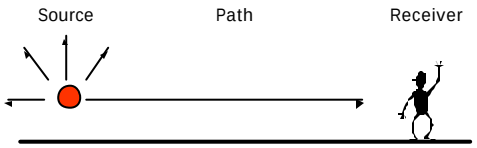
Source/Path/Receiver Concept



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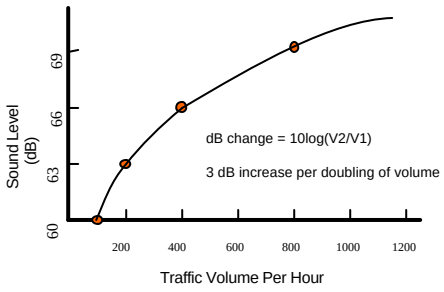
Volume of Traffic



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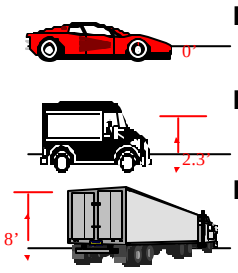
Vehicle Types



- **Automobiles**
  - passengers
  - 2-axles, 4-wheels
  - source height: 0 ft
- **Medium Trucks**
  - cargo
  - 2-axles, 6-wheels (duals)
  - source height: 2.3ft (.7m)
- **Heavy Trucks**
  - cargo
  - 3 or more axles
  - source height:8.0ft(2.44m)

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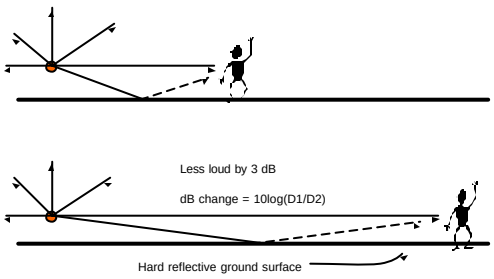
Geometric Relationship Between Traffic and Receiver



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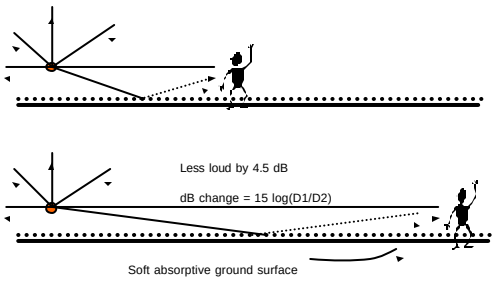
Geometric Relationship Between Traffic and Receiver



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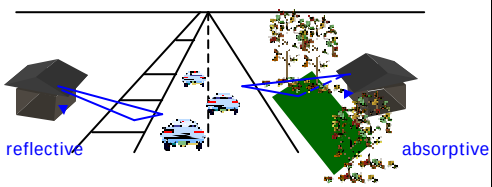
Acoustical Characteristics of the Ground

Hard Site
-3 dBA/DD

Soft Site
-4.5 dBA/DD



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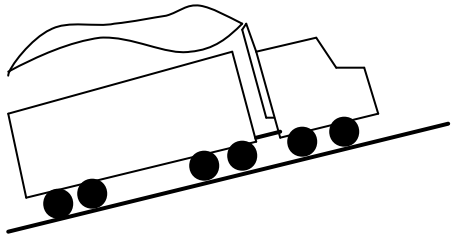
Grade of the Roadway



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Grade of the Roadway

Calgrade Heavy Truck Emission Levels

Grade%	Emission Level
	dBA
1	84.0
2	84.4
3	84.7
4	84.1
5	83.9
6	83.9
7	83.9

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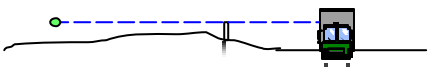
Barriers Between Traffic and the Receiver

Barrier just breaks the line of sight between the source and the receiver

~5dB noise reduction



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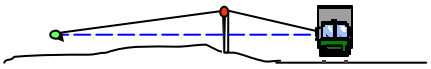
Barriers Between Traffic and the Receiver

As the barrier height increases the noise reduction increases

~8 dB noise reduction



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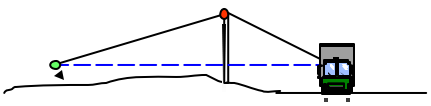
Barriers Between Traffic and the Receiver

As the barrier height increases the noise reduction increases

~10 dB noise reduction



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Meteorology

- Temperature
- Wind
- Humidity
- Rain

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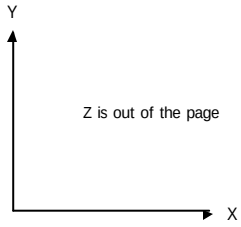
Three Dimensional X, Y, Z Coordinate System



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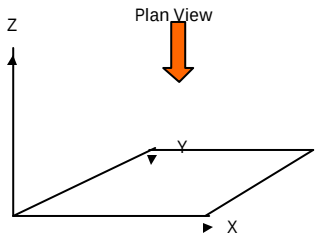
Three Dimensional X, Y, Z Coordinate System



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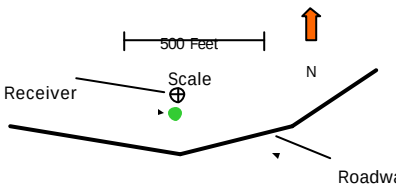
Three Dimensional X, Y, Z Coordinate System



Plan View of Roadway

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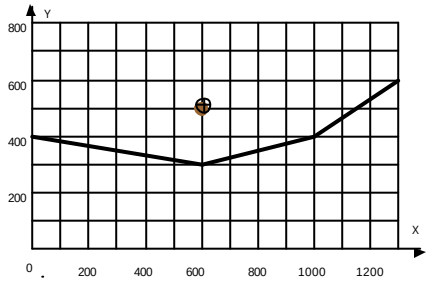
Three Dimensional X, Y, Z Coordinate System



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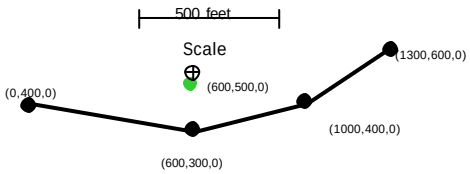
Three Dimensional X, Y, Z Coordinate System



Plan View of Roadway

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Input Parameters Used in Sound32 Analysis

- Lane and traffic data
  - geometric location of roadway lanes (X,Y,X)
  - volume and speed of autos, medium trucks, and heavy trucks
  - grade correction for heavy trucks

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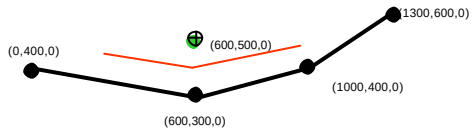
Input Parameters Used in Sound32 Analysis

- Barrier data
  - geometric location of the barrier (X ,Y, Z_0, Z)



Plan View of Roadway

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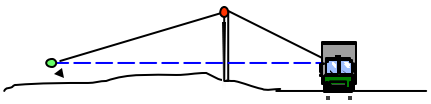
Input Parameters Used in Sound32 Analysis

- Barrier data
  - Type of barrier (masonry, masonry on jersey, concrete)



Masonry and concrete barriers are thin screen barriers and are treated the same acoustically.

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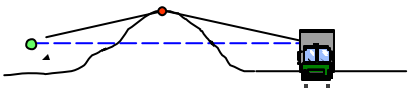
Input Parameters Used in Sound32 Analysis

- Barrier data
  - Type of barrier (earth-berm)



- The model provides 3 dB more noise reduction than a thin screen barrier.
- In practice the effect of a berm has been shown to be less.
- Earth-berms should generally be treated as thin screen barriers.
- Refer to Caltrans Technical Noise Advisory TAN-02-1.

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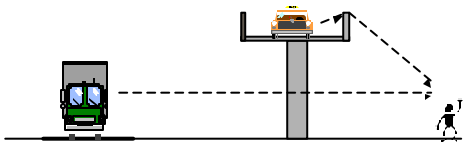
Input Parameters Used in Sound32 Analysis

- Barrier data
  - Barrier structure status



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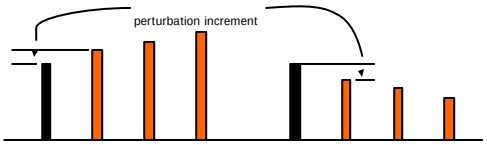
Input Parameters Used in Sound32 Analysis

- Barrier data
  - perturbation increment
  - maximum number of perturbations



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Input Parameters Used in Sound32 Analysis

- Receiver Data
  - Geometric location of receivers (X,Y,Z)
- Drop off rates
  - rate in dB per doubling of distance at which sound levels attenuate (3 dB or 4.5 dB per doubling of distance)
- K factor constants
  - correction or calibration factor in dB

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Input Parameters Used in Sound32 Analysis

- Emission levels
  - Reference energy mean emission levels (REMELS)
  - California (CALVENO)
  - National (FHWA)
- Factors not addressed in Sound32
  - Meteorology
  - Dense woods
  - Rows of houses

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Sound32 Modeling Methodology

- Fortran format input file is created
  - traffic lanes, barriers, and receivers are located spatially in a 3 dimension Cartesian coordinate system (X,Y, Z)
  - traffic volumes and speeds are defined
  - traffic noise emission levels and distance attenuation rates are defined

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Sound32 Input File

```
Sample File
T-Lane 1 Traffic Description, 1
 1000 , 65 , 40 , 65 , 20 , 65
T-Lane 2 Traffic Description, 2
 1500 , 65 , 40 , 65 , 20 , 65
L-Lane 1 Lane Description, 1
N,-5000.,0,0,Lane 1 Point 1
N,-2500.,0,0,Lane 1 Point 2
N,0.,0,0,Lane 1 Point 3
N,2500.,0,0,Lane 1 Point 4
N,5000.,0,0,Lane 1 Point 5
L-Lane 2 Lane Description, 2
N,-5000.,10,0,Lane 2 Point 1
N,-2500.,10,0,Lane 2 Point 2
N,0.,10,0,Lane 2 Point 3
N,2500.,10,0,Lane 2 Point 4
N,5000.,10,0,Lane 2 Point 5
B-Barrier 1, 1 , 1 , 1 ,3
-5000.,50,0,10,B1 P1
5000.,50,0,10,B1 P2
B-Barrier 2, 2 , 2 , 1 ,3
-5000., -50,0,10,B2 P1
5000.,- 50,0,10,B2 P2
R, 1 , 67 ,500
-50,100,5.,Rec. 1
R, 2 , 67 ,500
50,100,5.,Rec. 2
R, 3 , 67 ,500
-50, -100,5.,Rec. 3
R, 4 , 67 ,500
50,100,5.,Rec. 4
D, 4.5
ALL,ALL
K,-1
ALL,ALL
C,C
```

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Sound32 Modeling Methodology

- Input file can be created using a text editor or the Caltrans “front end”
- Traffic noise levels at receivers are then calculated
- Output file with results called SOUND32.OUT is created and overwritten each time results are calculated. The file is placed in the SOUND32 directory.

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Sound32 Output File

```
SAMPLE FILE

1
      BARRIERDATA
      ***********

BAR          BARRIER HEIGHTS          BAR
ELE  0  1  2  3  4  5  6  7  ID     LENGTH   TYPE
-------------------------------------------------------
 1    - 7.  8.  9.  10.* 11.  12.  13.  B1 P1    10000.0

 2    - 7.  8.  9.  10.* 11.  12.  13.  B2 P1    10000.0
-------------------------------------------------------
      0  1  2  3  4  5  6  7
1
REC REC ID   DNL  PEOPLE   LEQ(CAL)
-------------------------------------
 1 REC_1   67.   500.   60.1
 2 REC_2   67.   500.   60.1
 3 REC_3   67.   500.   62.9
 4 REC_4   67.   500.   60.1
BARRIER HEIGHT INDEX FOR EACH BARRIER SECTION
  4  4
CORRESPONDING BARRIER HEIGHTS FOR EACH SECTION
10.10.
```

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Sound32 Examples

- Example 1. Simple 2 lane highway with 3 receivers
- Example 1A. Simple 2 lane highway with 3 receivers and 1 barrier
- Example 1B. Simple 2 lane highway with 3 receivers and 1 perturbable barrier

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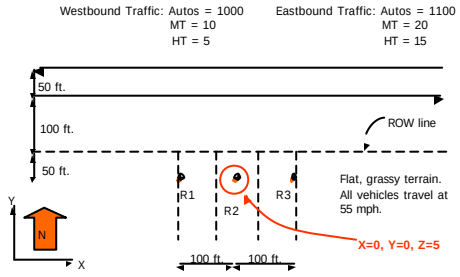
Example 1



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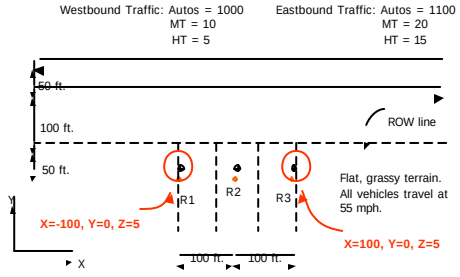
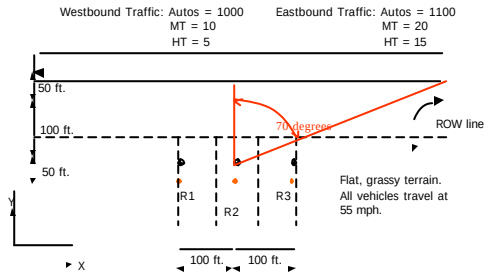
Example 1



41

Example 1



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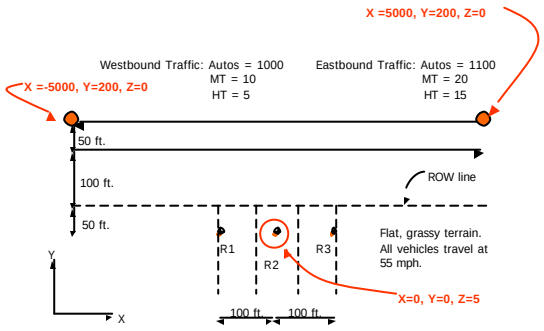
Example 1



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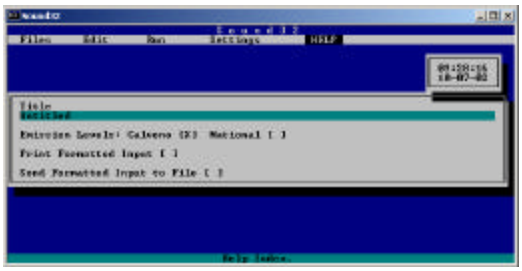
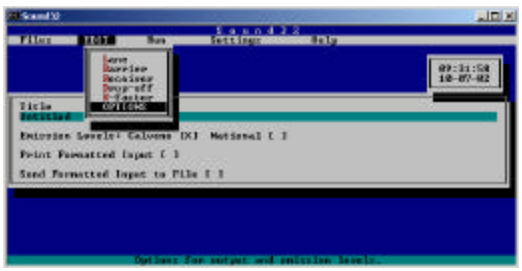
Example 1



44

Example 1



Use the **left and right arrow** keys to select the desired item from the main menu bar.
This will open up the sub-menu.
Use the **up and down arrow** keys to select items from the sub-menu.

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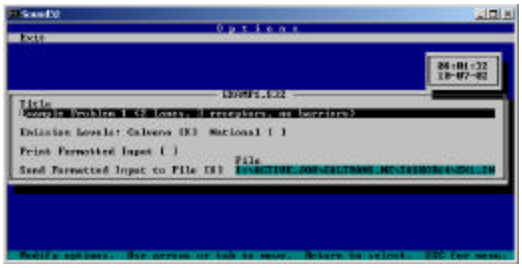
Example 1



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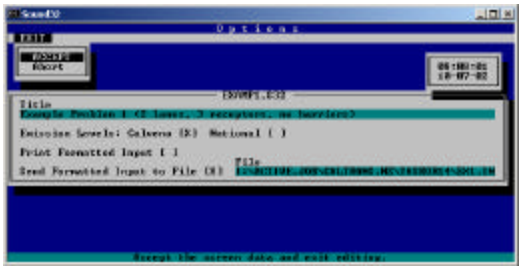
Example 1



The **escape** key activates the menu bar.
Use the up and down arrow keys to select “accept” or “abort”.

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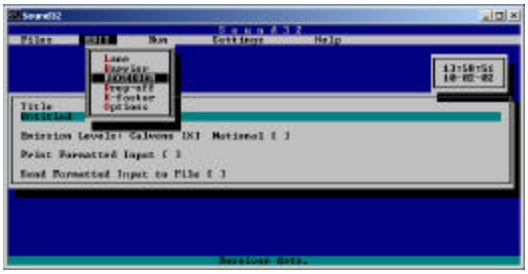
Example 1



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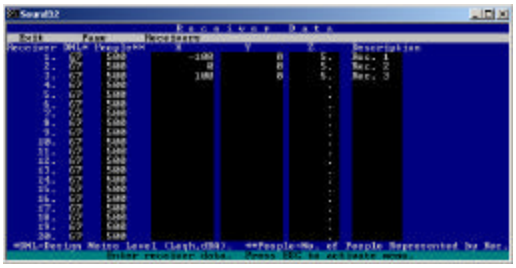
Example 1



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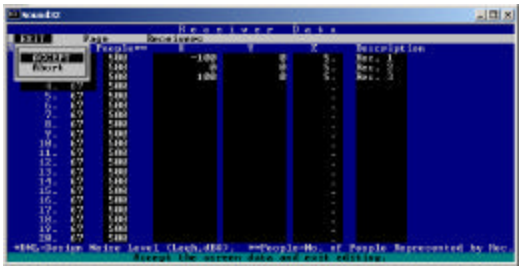
Example 1



The **escape** key activates the menu bar.
Use the left and right arrow keys to select he desired menu item.

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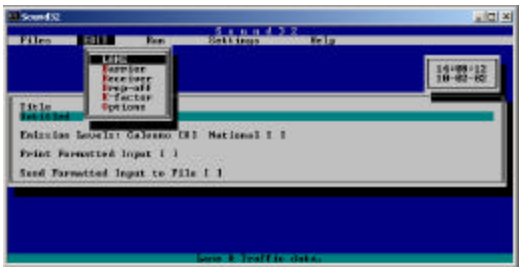
Example 1



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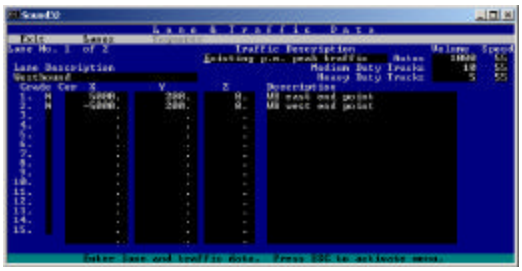
Example 1



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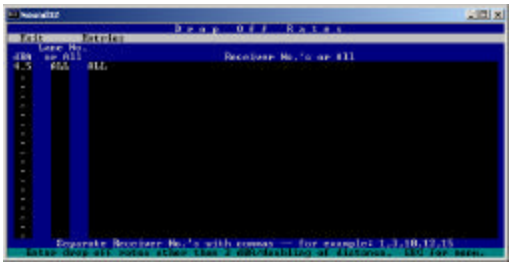
Example 1



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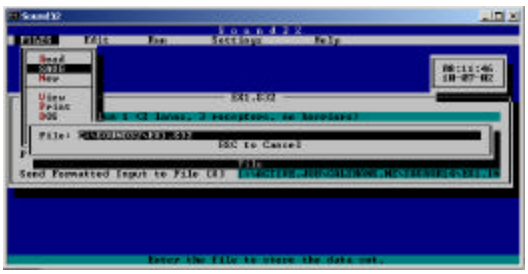
Example 1



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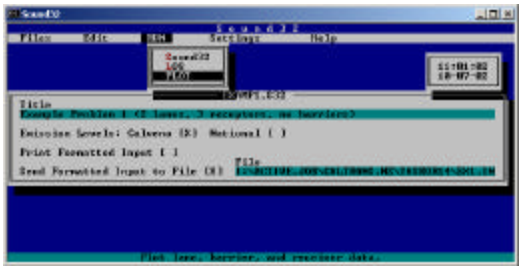
Example 1



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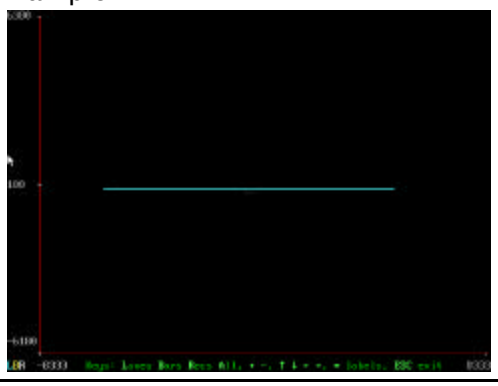
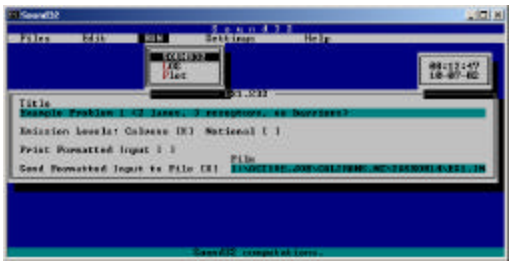
Example 1



Example 1



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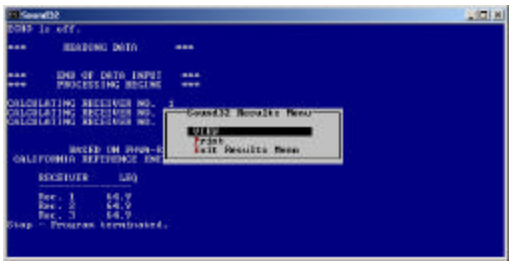
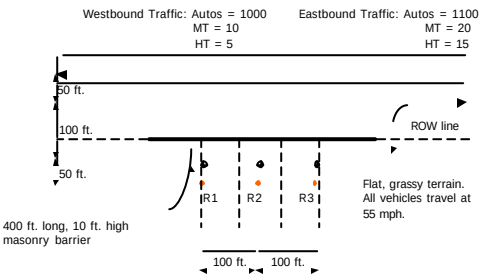
Example 1



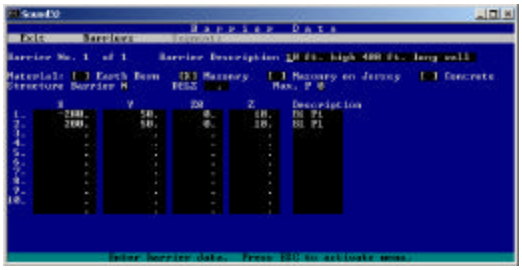
Example 1

```
Example Problem 1 (2 lanes, 3 receptors, no barriers)
T-Existing p.m. peak traffic, 1
 1000 , 55 , 10 , 55 , 5 , 55
T-Existing p.m. peak traffic, 2
 1100 , 55 , 20 , 55 , 15 , 55
L-Westbound, 1
N,5000.,200,0,WB east end point
N,-5000.,200,0,WB west end point
L-Eastbound, 2
N,-5000.,150,0,eastbound west end point
N,5000.,150,0,eastbound east end point
R, 1 , 67 ,500
-100,0,5.,Rec. 1
R, 2 , 67 ,500
0,0,5.,Rec. 2
R, 3 , 67 ,500
100,0,5.,Rec. 3
D, 4.5
ALL,ALL
C,C
```


Example 1A

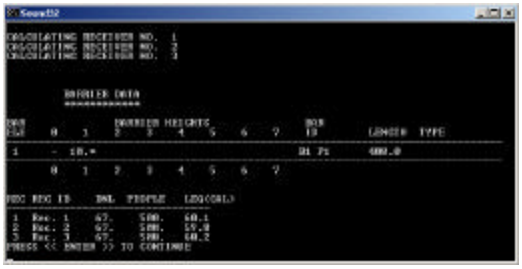


Example 1A



61

Example 1A



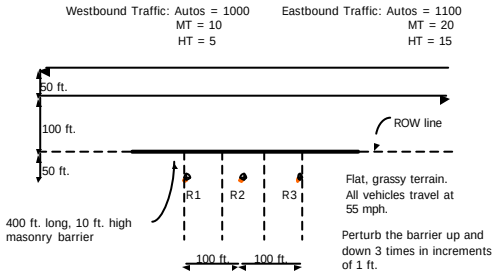
62

Example 1A

```
Example Problem 1A (2 lanes, 3 receptors, 10 ft. high 400 ft. long barrier)
T-Existing p.m. peak traffic, 1
 1000 , 55 , 10 , 55 , 5 , 55
T-Existing p.m. peak traffic, 2
 1100 , 55 , 20 , 55 , 15 , 55
L-Westbound, 1
N,5000.,200,0,WB east end point
N,-5000.,200,0,WB west end point
L-Eastbound, 2
N,-5000.,150,0,eastbound west end point
N,5000.,150,0,eastbound east end point
B-10 ft. high 400 ft. long wall, 1 , 2 , 0 ,0
-200.,50,0,10,B1 P1
200.,50,0,10,B1 P1
R, 1 , 67 ,500
-100,0,5.,Rec. 1
R, 2 , 67 ,500
0,0,5.,Rec. 2
R, 3 , 67 ,500
100,0,5.,Rec. 3
D, 4.5
ALL,ALL
C,C
```

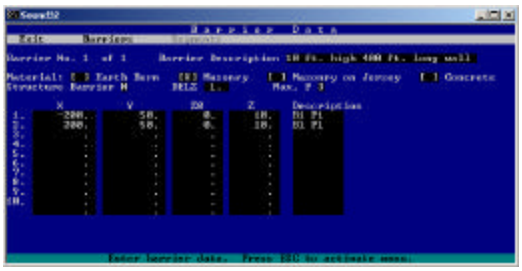
63

Example 1B



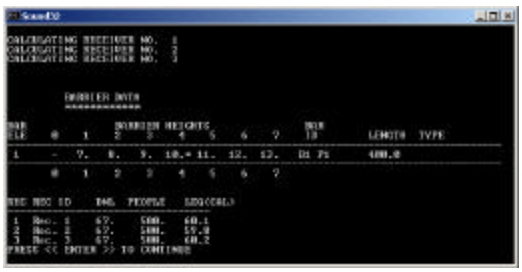
64

Example 1B



65

Example 1B



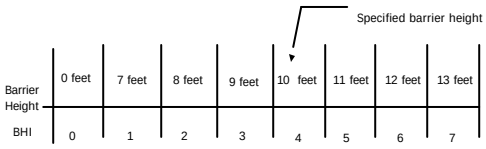
66

Example 1B

```
Sample Problem 1B (2 lanes, 3 receptors, barrier with perturbations)
T-Existing p.m. peak traffic, 1
 1000 , 55 , 10 , 55 , 5 , 55
T-Existing p.m. peak traffic, 2
 1100 , 55 , 20 , 55 , 15 , 55
L-Westbound, 1
N,5000.,200,0,WB east end point
N,-5000.,200,0,WB west end point
L-Eastbound, 2
N,-5000.,150,0,eastbound west end point
N,5000.,150,0,eastbound east end point
B-10 ft. high 400 ft. long wall, 1 , 2 , 1 ,3
-200.,50,0,10,B1 P1
200.,50,0,10,B1 P1
R, 1 , 67 ,500
-100,0,5.,Rec. 1
R, 2 , 67 ,500
0,0,5.,Rec. 2
R, 3 , 67 ,500
100,0,5.,Rec. 3
D, 4.5
ALL,ALL
VC,C
PC output option:  0 ,I:\ACTIVE.JOB\CALTRANS.NZ\TASKOR14\EX1B.I
```

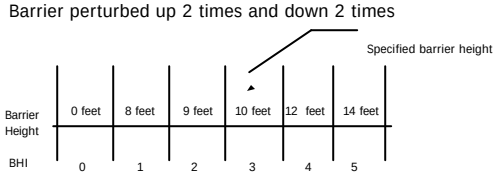

Barrier Height Index

Barrier perturbed up 3 times and down 3 times



Barrier Height Index

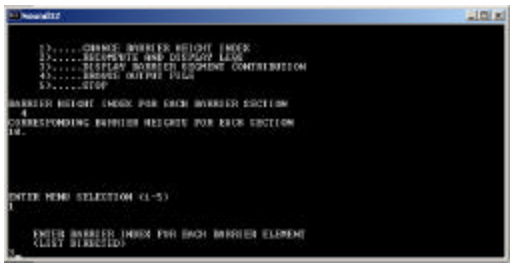
Barrier perturbed up 2 times and down 2 times



Example 1B

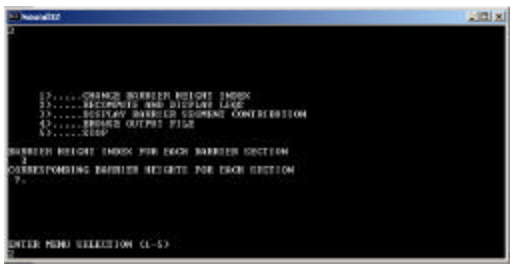
70

Example 1B



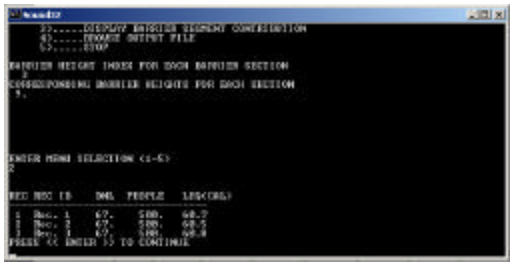
71

Example 1B



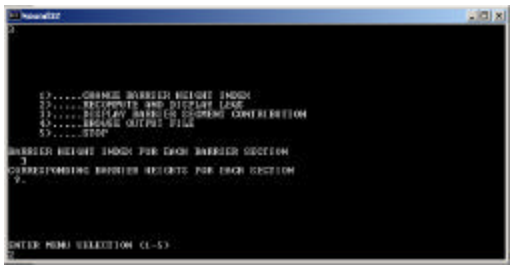
72

Example 1B



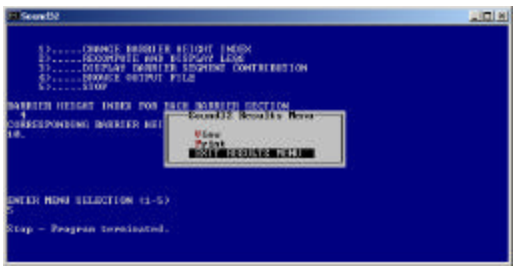
73

Example 1B



74

Example 1B



75

Example 1 Results

Example 1 Sound32 Sound Level Results

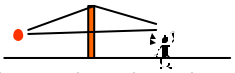
Receptor	Example 1 (no barrier)	Example 1B (7 ft. barrier)	Example 1B (8 ft. barrier)	Example 1B (9 ft. barrier)	Example 1A (10 ft. barrier)	Example 1B (11 ft. barrier)	Example 1B (12 ft. barrier)	Example 1B (13 ft. barrier)
1	64.9	62.1	61.4	60.7	60.1	59.5	58.9	58.5
2	64.9	62	61.3	60.5	59.8	59.1	58.5	57.9
3	64.9	62.1	61.5	60.8	60.2	59.6	59	58.5

Example 1 Sound32 Barrier Insertion Loss Results

Receptor	No Barrier	7 Ft. Barrier	8 Ft. Barrier	9 Ft. Barrier	10 Ft. Barrier	11 Ft. Barrier	12 Ft. Barrier	13 Ft. Barrier
1	0	-2.8	-3.5	-4.2	-4.8	-5.4	-6	-6.4
2	0	-2.9	-3.6	-4.4	-5.1	-5.8	-6.4	-7
3	0	-2.8	-3.4	-4.1	-4.7	-5.3	-5.9	-6.4

76

Zero Height Barrier, Berm Effect



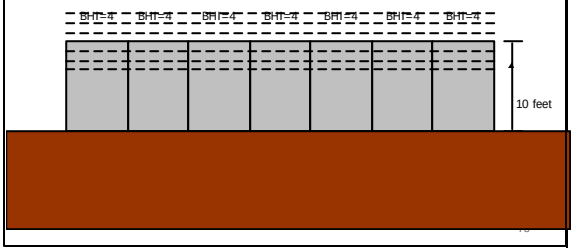
Barrier Height (ft.)	Leq (Masonry	I.L.	Leq (Berm)	I.L.	Berm Effect	Using BHI
No Barrier	72.3	-	-		-	
0	68.1	-4.2	66.7	-5.6	-1.4	72.1
1	67.5	-4.8	65	-7.3	-2.5	68.3
2	67.3	-5	64.7	-7.6	-2.6	67.9
4	67.6	-4.7	64.6	-7.7	-3	66.9
6	65.5	-6.8	62.5	-9.8	-3	65.4
8	63.9	-8.4	60.9	-11.4	-3	63.8
10	62.1	-10.2	59.1	-13.2	-3	62.1

- Zero height barrier results in noise reduction.
- When barrier height index is set to 0 the results are for no barrier, not a zero height barrier.

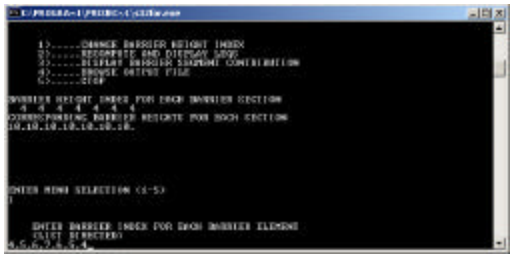
77

Perturbing Barrier Segments

- Individual segments can be perturbed to different heights.



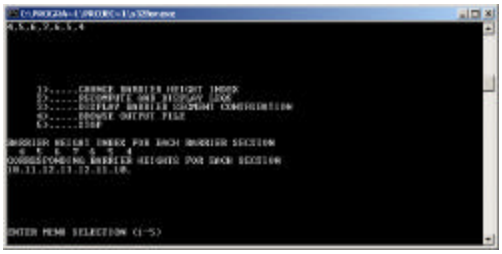
Perturbing Barrier Segments



Barrier height index for each segment is separated by a comma.

79

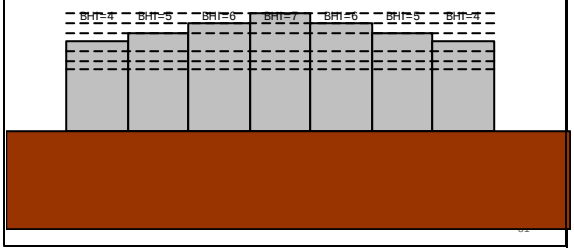
Perturbing Barrier Segments



Corresponding heights are calculated and shown.

80

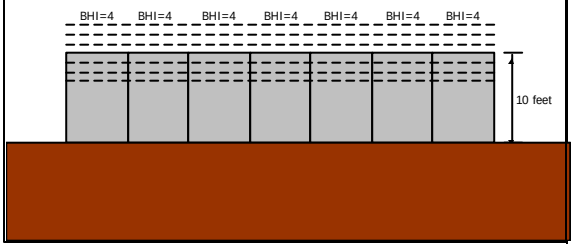
Perturbing Barrier Segments



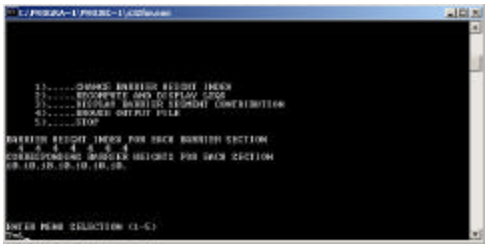
Perturbing Barrier Segments

- If all of the segments are perturbed to the same height a “list directed” input is used i.e.:

7*6



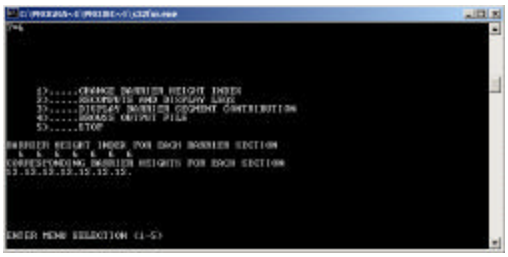
Perturbing Barrier Segments



Barrier height index is indicated with a “list directed” input.

83

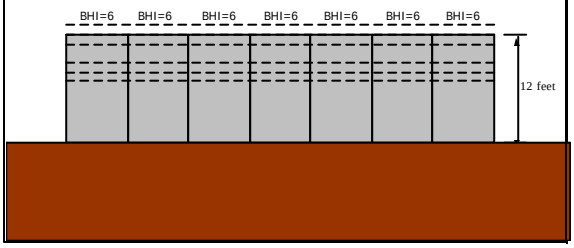
Perturbing Barrier Segments



Corresponding heights are calculated and shown.

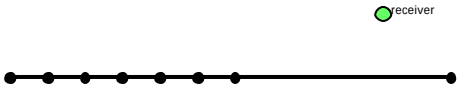
84

Perturbing Barrier Segments



Perturbing Barrier Segments

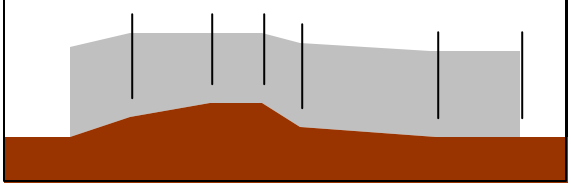
- Use short barrier segments and the zero barrier height index (i.e. the “no barrier” index) to determine the length of a sound barrier.



86

Perturbing Barrier Segments

- Barrier segments do not have to be the same height at each end.
- Sound32 reports the average segment height.



Impact and Abatement Criteria

- 23CFR772
  - Provides procedures for noise studies and noise abatement studies
  - Provides noise abatement criteria
  - Subject to interpretation by State DOTs

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Impact and Abatement Criteria

- Caltrans Traffic Noise Analysis Protocol (CATNAP)
  - Provides Caltrans policy and Caltrans interpretation of 23CFR772
  - Technical Noise Supplement (TENS) is a supplement to the Protocol that covers procedures, practices, and background information.

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Impact and Abatement Criteria

Activity Category	NAC, Hourly A-Weighted Noise Level, dBA $L_{eq}(h)$	Description of Activities
A	57 Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 Exterior	Picnic areas, recreation areas, playgrounds, active sport areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

90

Impact and Abatement Criteria

- Traffic noise impact occurs if the predicted design year sound level:
  - Approaches or exceeds (i.e. is within 1 dB of) the NAC
  - substantially exceeds the existing year sound level (i.e. is 12 dB greater than the existing year sound level)

91

Impact and Abatement Criteria

- Feasibility of Abatement
  - Abatement is acoustically feasible if it provides 5 dB of noise reduction at impacted receivers.
  - Other non-acoustical factors may affect the overall feasibility of abatement

92

Impact and Abatement Criteria

- Reasonableness of abatement
  - predicted design year noise level
  - change in noise level
  - achievable noise reduction
  - date of development along the highway
  - cost
  - life cycle of abatement measures
  - environmental impacts of abatement measures
  - opinions of impacts residences
  - input from public and local agencies
  - social, economic, environmental, legal, and technological factors.

93

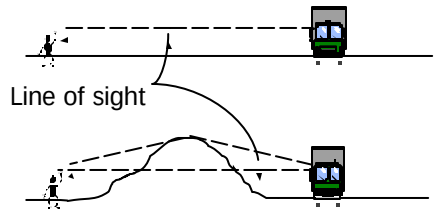
Impact and Abatement Criteria

- Preliminary reasonableness determination

94

Line of Sight (LOS) Analysis

- Meaning and importance of line of sight



95

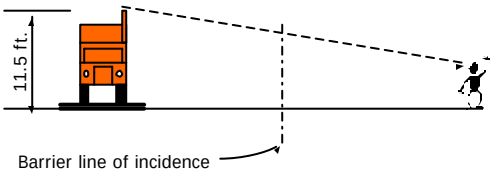
Line of Sight (LOS) Analysis

- Background on line of sight analysis (1993 Caltrans Technical Advisory)

96

Line of Sight (LOS) Analysis

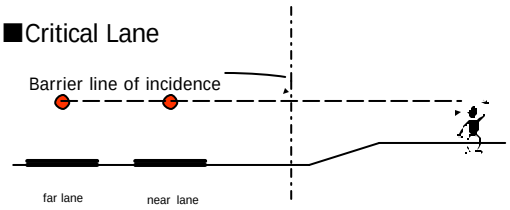
- Barriers Designed the Break the LOS for 11.5 Foot High Truck Stack



97

Line of Sight (LOS) Analysis

- Critical Lane

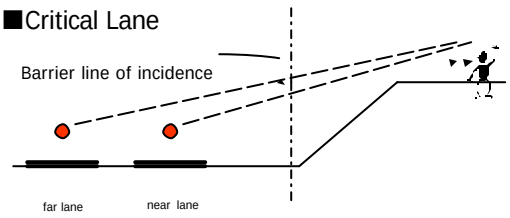


Both the near lane and far lane are critical

98

Line of Sight (LOS) Analysis

- Critical Lane

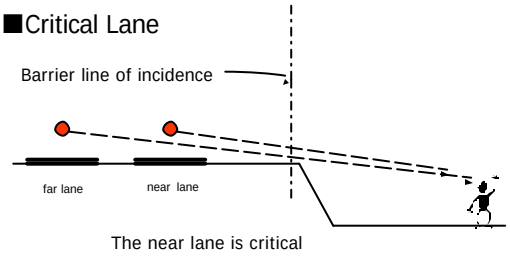


The far lane is critical

99

Line of Sight (LOS) Analysis

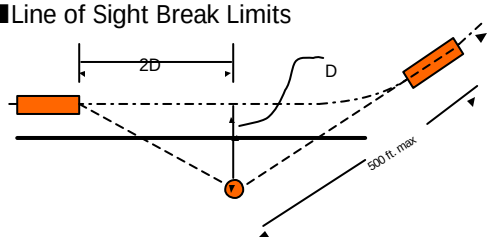
■Critical Lane



100

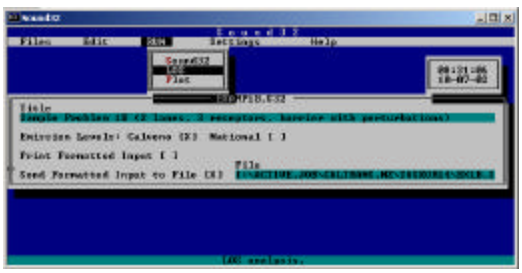
Line of Sight (LOS) Analysis

■Line of Sight Break Limits



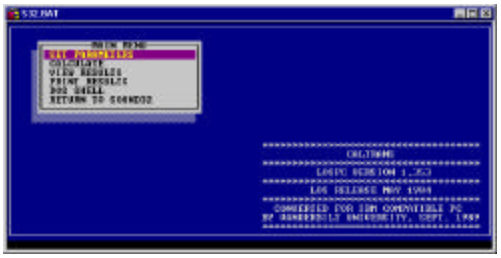
101

Sound32 LOS Module



102

Sound32 LOS Module

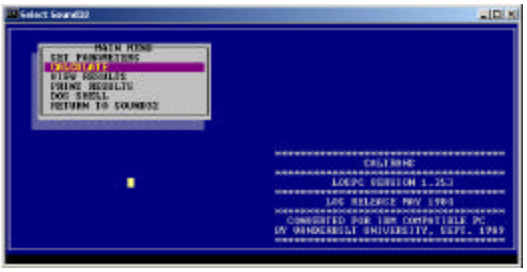


103

Sound32 LOS Module

104

Sound32 LOS Module



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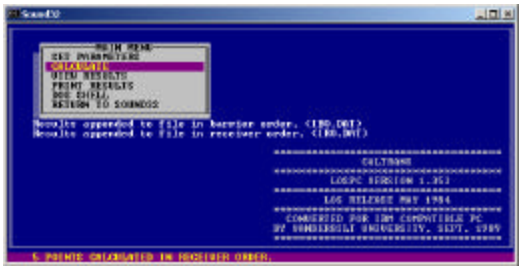
Sound32 LOS Module



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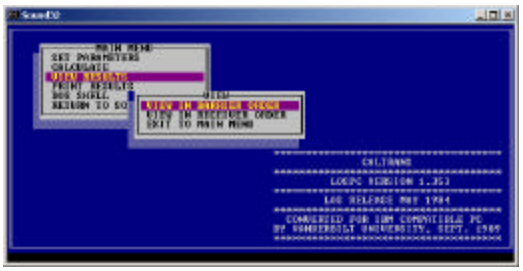
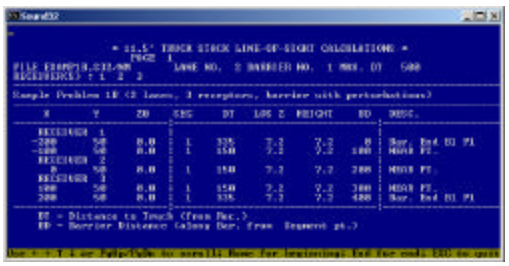
Sound32 LOS Module



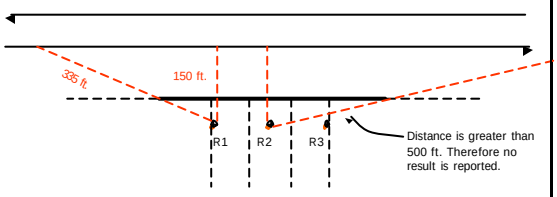
107

Sound32 LOS Module



108

Sound32 LOS Module



109

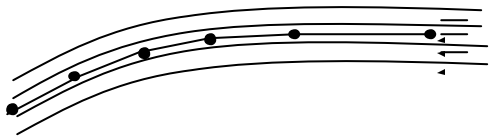
Modeling Techniques

- Information needed to conduct modeling
  - aerial photographs
  - Layout, elevation, and profile drawings for existing and project conditions
  - traffic data (volume, speed, classifications) for existing and project conditions

110

Modeling Techniques

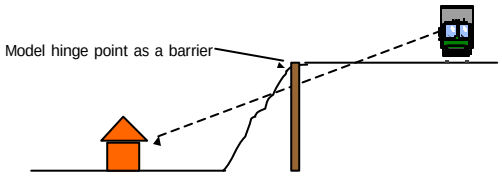
- In most cases, use single lanes to model directional traffic (i.e. don't model each lane)
- In some situations modeling of individual lanes may be appropriate (i.e. receivers are close to the highway, heavy trucks use outside lanes)



111

Modeling Techniques

- Use barriers to model cut/fill hinge points, topographic features, structures, etc.



The location of the bottom of the barrier does not effect the barrier noise reduction

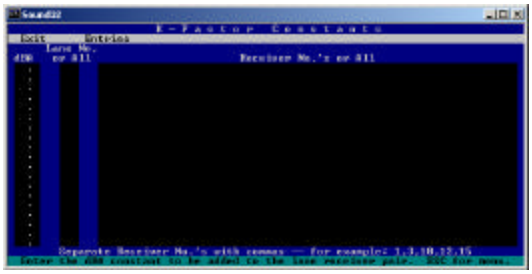
112

Modeling Techniques

- Determine element coordinates by manual scaling or digitizing
- Use K factors to “calibrate” the model.

113

Modeling Techniques



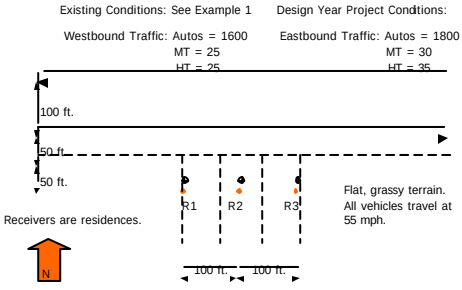
114

Sound32 Exercises

- Barrier design problem
- Depressed roadway problem
- Overcrossing Problem

115

Barrier Design Problem



116

Barrier Design Results

Barrier Design Problem Results

Receiver	No Barrier	9 Ft. High Wall					
		200 Ft. Length	I.L	400 Ft. Length	I.L	44 Ft. Return*	I.L
1	69.3	67.4	-1.9	64.3	-5.0	64.2	-5.1
2	69.3	64.8	-4.5	64.0	-5.3	63.7	-5.6
3	69.3	67.3	-2.0	64.3	-5.0	64.3	-5.0

Receiver	No Barrier	10 Ft. High Wall					
		200 Ft. Length	I.L	340 Ft. Length	I.L	42 Ft. Return*	I.L
1	69.3	67.2	-2.1	64.2	-5.1	64.2	-5.1
2	69.3	64.3	-5.0	63.4	-5.9	62.8	-6.5
3	69.3	67.1	-2.2	64.3	-5.0	64.3	-5.0

Receiver	No Barrier	8 Ft. High Wall					
		200 Ft. Length	I.L	Infin. Length	I.L	Infin.Return*	I.L
1	69.3	67.2	-2.1	64.2	-5.1	64.6	-4.7
2	69.3	64.3	-5.0	63.4	-5.9	62.8	-6.5
3	69.3	67.1	-2.2	64.3	-5.0	64.7	-4.6

*length of wall parallel to roadway is 200 feet.

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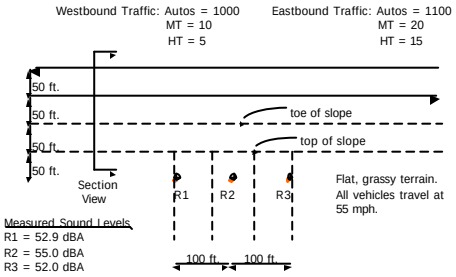
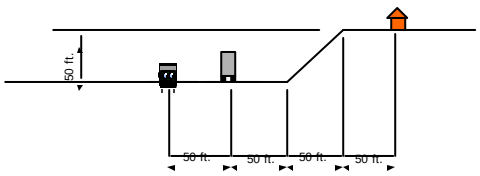
Depressed Roadway Problem



118

Depressed Roadway Problem

Section View



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Depressed Roadway Problem

- Use a berm barrier to model the shielding effects of the top-of-slope
- Run the model and compare the results to the measured sound levels
- Develop K factors by comparing measured results to modeled results
- Put K factors in to the model to show that modeled result not match the measured results.

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Depressed Roadway

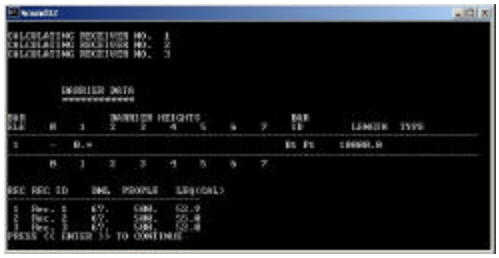
Results with no K factor.

Depressed Roadway Problem

(Input file without K factors)

```
Depressed Road Problem 1.
T-Existing p.m. peak traffic, 1
 1000 , 55 , 10 , 55 , 5 , 55
T-Existing p.m. peak traffic, 2
 1100 , 55 , 20 , 55 , 15 , 55
L-Westbound, 1
N,5000.,200,0,WB east end point
N,-5000.,200,0,WB west end point
L-Eastbound, 2
N,-5000.,150,0,eastbound west end point
N,5000.,150,0,eastbound east end point
B-Hill Cut, 1 , 1 , 0 ,0
-5000.,50,50,50,
5000.,50,50,50,
R, 1 , 67 ,500
-100,0,55.,Rec. 1
R, 2 , 67 ,500
0,0,55.,Rec. 2
R, 3 , 67 ,500
100,0,55.,Rec. 3
D, 4.5
ALL,ALL
C,C
```


Depressed Roadway



Results with K factor.

Depressed Roadway Problem

(Input file with K factors)

```
Depressed Road Problem 1.
T-Existing p.m. peak traffic, 1
 1000 , 55 , 10 , 55 , 5 , 55
T-Existing p.m. peak traffic, 2
 1100 , 55 , 20 , 55 , 15 , 55
L-Westbound, 1
N,5000..200,0,WB east end point
N,-5000..200,0,WB west end point
L-Eastbound, 2
N,-5000..150,0,eastbound west end point
N,5000..150,0,eastbound east end point
B-Hill Cut,1 , 1 , 0 ,0
-5000..50,50,50,
5000..50,50,50,
R, 1 , 67 ,500
-100,0,55.,Rec. 1
R, 2 , 67 ,500
0,0,55.,Rec. 2
R, 3 , 67 ,500
100,0,55.,Rec. 3
D, 4.5
ALL,ALL
K,-0.8
ALL,1
K, 1.3
ALL,2
K,-1.7
ALL,3
C,C
```

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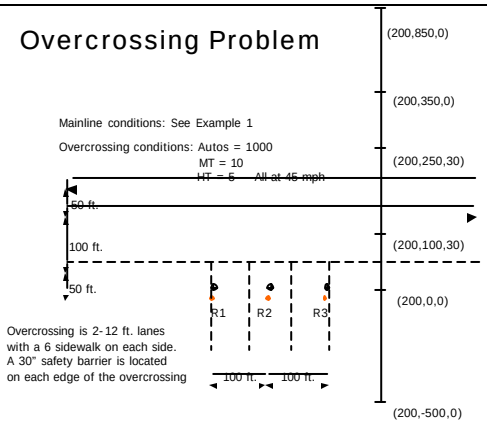
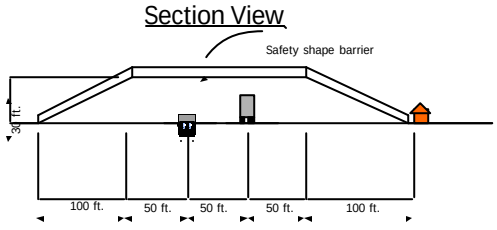
Overcrossing Problem



125

Overcrossing Problem



126

Overcrossing Problem

- Model the two lane overcrossing roadway as a single lane.
- At the receivers the safety barrier on the overcrossing will shield noise from traffic on the overcrossing but not from the highway. A structure barrier must therefore be used to model the safety barrier.
- For the purpose of keeping track of barrier coordinates, locate the bottom of the barrier (Z_0) at elevation of the overcrossing roadway.
- The elevation of the top of the safety barrier is its absolute elevation, not its elevation relative to the bottom of the barrier.

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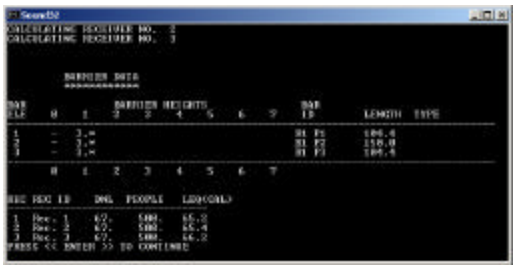
Overcrossing Problem



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Overcrossing Problem

```
Overcrossing Problem
T-Existing p.m. peak traffic, 1
 1000 , 55 , 10 , 55 , 5 , 55
T-Existing p.m. peak traffic, 2
 1100 , 55 , 20 , 55 , 15 , 55
T-Existing p.m. peak traffic, 3
 1000 , 45 , 10 , 45 , 5 , 45
L-Westbound, 1
N,5000,,200,0,WB east end point
N,-5000,,200,0,WB west end point
L-Eastbound, 2
N,-5000,,150,0,eastbound west end point
N,5000,,150,0,eastbound east end point
L-new overcrossing, 3
Y,200,,-500,0,south end point
Y,200,,0,0,
Y,200,,100,30,
Y,200,,250,30,
Y,200,,350,0,
Y,200,,850,0,north end point
B-safety barrier, 1 , 94 , 0 ,0
3
182.,0,0,2.5,
182.,100,30,32.5,
182.,250,30,32.5,
182.,350,0,2.5,
R, 1 , 67 ,500
-100,0,5.,Rec. 1
R, 2 , 67 ,500
0,0,5.,Rec. 2
R, 3 , 67 ,500
100,0,5.,Rec. 3
D, 4.5
ALL,ALL
VC, C
PC output option:  0 ,I:\ACTIVE.JOB\CALTRANS.NZ\TASKOR14\OC.IN
```

129

LeqV2

- Simple version of FHWA -RD-77-108
- Evaluates noise at one receiver only
- Evaluates up to 8 roadway elements
- Elements define traffic data and geometric relationships between the receiver, barriers, shoulders/cuts, and the roadway.
- Roadway and barrier angles and distances to roadways and barriers are used rather than an X, Y, Z coordinate system.

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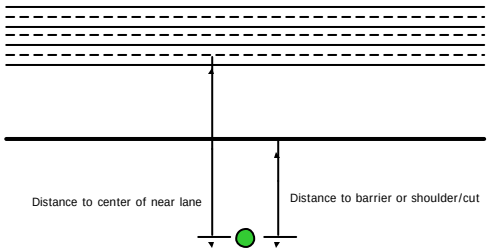
LeqV2



All horizontal dimensions are relative to the receiver

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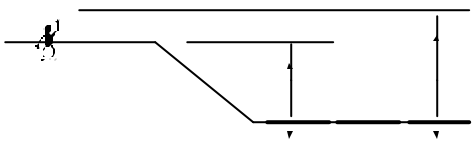
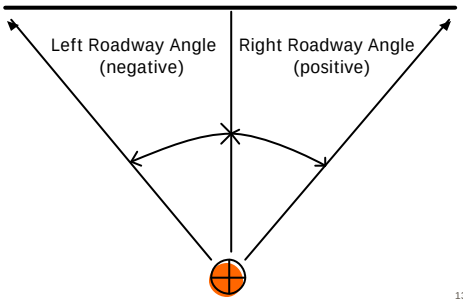
LeqV2



All vertical dimensions are relative to the surface of the roadway

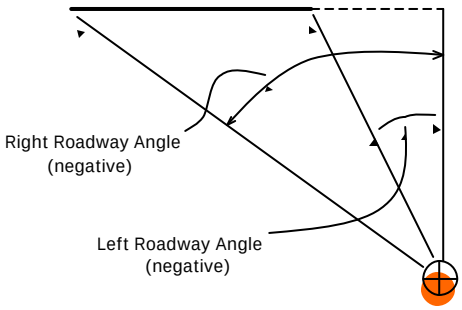
132

LeqV2 Roadway Angles



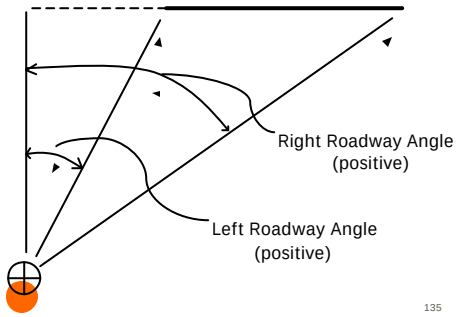
133

LeqV2 Roadway Angles



134

LeqV2 Roadway Angles



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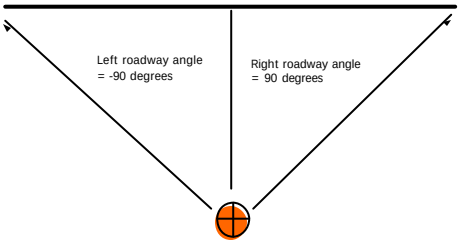
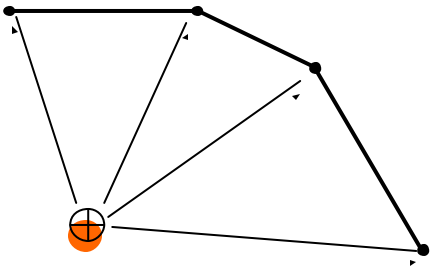
LeqV2 Roadway Angles

For an infinitely long roadway:



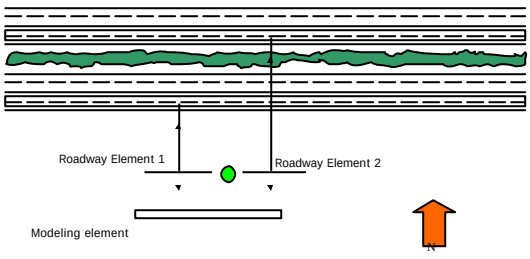
136

LeqV2 Roadway Angles



137

LeqV2 Roadway Angles



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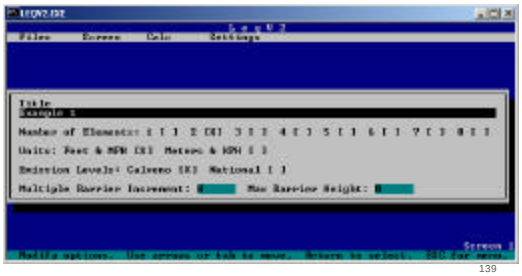
LeqV2 Data Entry

■ Main Menu Bar



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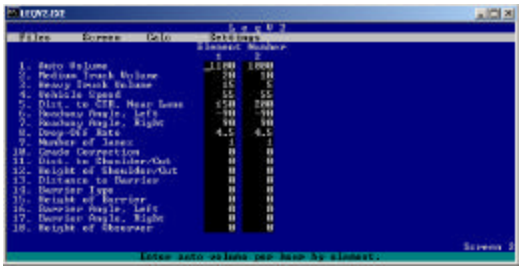
LeqV2 Data Entry



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LeqV2 Results

Title: Example 1
Date: 10-07 -2002

INPUT DATA (Feet & MPH)	ELEMENT NUMBER 1	2
1. Auto Volume	1100	1000
2. Medium Truck Volume	20	10
3. Heavy Truck Volume	15	5
4. Vehicle Speed	55	55
5. Dist. to CTR. Near Lane	150	200
6. Roadway Angle, Left	-90	-90
7. Roadway Angle, Right	90	90
8. Drop-Off Rate	4.50	4.50
9. Number of lanes	1	1
10. Grade Correction	0	0
11. Dist. to Shoulder/Cut	0	0
12. Height of Shoulder/Cut	0	0
13. Distance to Barrier	0	0
14. Barrier Type	0	0
15. Height of Barrier	0	0
16. Barrier Angle, Left	0	0
17. Barrier Angle, Right	0	0
18. Height of Observer	0	0

OUTPUT DATA (Based on CALIFORNIA Ref. Energy Mean Emission Levels)

NO BARRIER TOTAL LEQ = 65 DBA (APPROX. L10 67 DBA)

Title: Example 1
Date: 10-07 -2002

OUTPUT DATA (HOURLY LEQS)	ELEMENT NUMBER 1	2
NO BARRIER		
Leq Auto	61.97	59.68
Leq Med. Trucks	51.69	46.81
Leq Heavy Trucks	54.41	47.76
ELEMENT TOTALS	63.00	60.16

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Sound2000

- Sound2000 is a Windows-based interface to Sound32.
- Sound2000 provides
  - Windows-based tools (open, close, cut, paste, etc)
  - A supplemental graphing interface
  - STAMINA 2.0 import and export capabilities
  - Saving of unique output files for each modeling run.
- Sound2000 is under development and is available for use and evaluation.
- Sound2000 information is located at:
  www.dot.ca.gov/hq/env/noise

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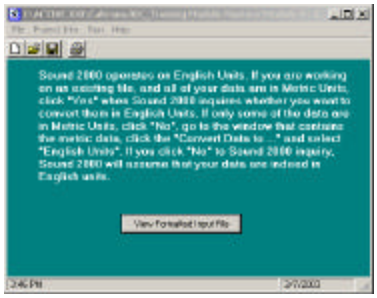
Sound2000



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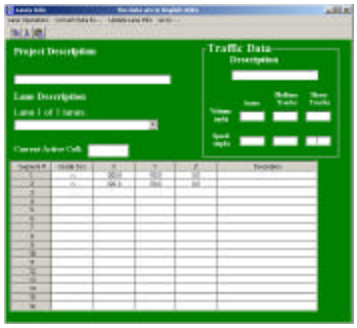
Sound2000



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Sound2000

- Information and tools available on the Sound2000 website include:
  - Sound2000 program download,
  - update information,
  - feedback form,
  - users group information,
  - on-line video training.
- Users are strongly encouraged to check the Sound 2000 web site on a regular basis to determine if updated versions are available.
- Users can also register to the Sound2000 users group to receive an email when updated versions are released.

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Concluding Remarks

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